

Section 8. LCD Display

Freescall Embedded GUI and TWR-LCD

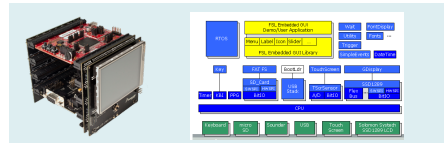
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Module Objectives

- ▶ This session will introduce you to the..
 - Features of the new TWR-LCD Module
 - Freescall Graphic Library Solution for Embedded MCU's
 - Documentation and Demo Software available.



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Introduction

- ▶ Driving graphics LCD panels normally requires a dedicated MPU
- ▶ Solutions such as the Coldfire MCF532x, MCF5227x or i.MX devices have been specifically designed for this purpose
- ▶ Recently, a number of new LCD displays have been released to the market which have LCD controllers integrated onto the LCD glass
- ▶ A simple SPI or 8/16 bit parallel interface can be driven by any microcontroller

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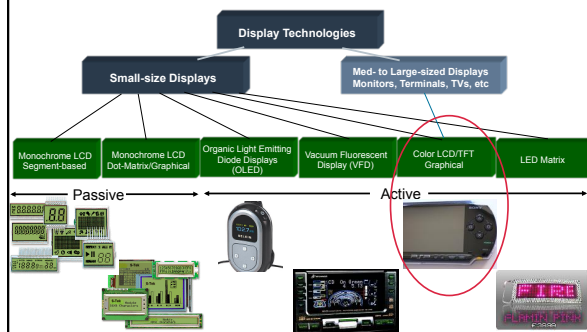
Smart vs Dumb LCD Panels & Bus requirements

- ▶ Dumb LCD TFT panels are very much like DRAM's
 - ❑ No on-board frame buffer or graphics engine
 - ❑ Cell's need to be refreshed periodically
 - ❑ Refreshing uses a lot of bus bandwidth
 - ❑ Cheaper but require LCD controller
- ▶ Smart LCD TFT panels – Like Static RAM
 - ❑ LCD is refreshed from on-board RAM
 - ❑ CPU bus bandwidth is only used when data must be changed
 - ❑ Requires significantly less CPU bus bandwidth
 - ❑ More expensive but does not require LCD controller

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Display Spectrum

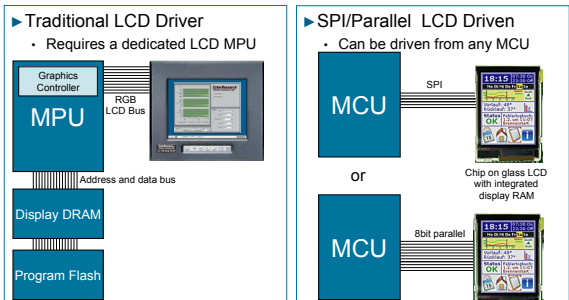


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LCD Driving Methods




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Peripheral Module: TWR-LCD Graphical LCD Module

TWR-LCD




Launch Date:
Apr 26, 2010

Features:

- 3.2" TFT QVGA display
- SPI and CPU interface
- Touch screen interface
- 5-position navigation switch
- Piezo buzzer
- Temperature sensor
- micro SD card slot
- Measurement port with current sensing circuitry
- Standalone mode

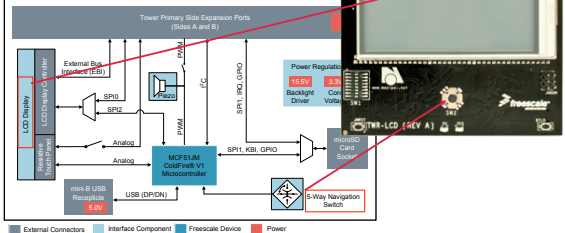
Resale:
TWR-LCD = \$99



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TWR-LCD Graphical LCD Module Block Diagram

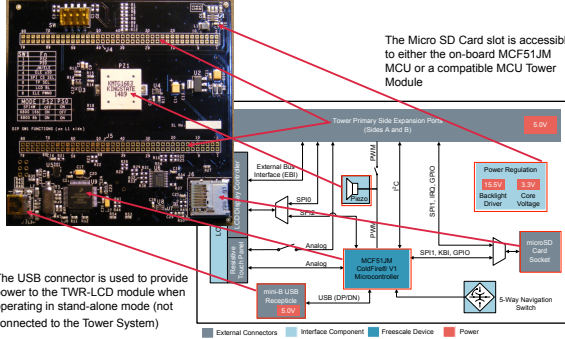
- Truly Semiconductor 3.2" TFT LCD with an analog resistive touch overlay
- The switch will allow user interaction with the TWR-LCD providing a method to indicate Up, Down, Right, Left and Select.



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TWR-LCD Graphical LCD Module Block Diagram

The Micro SD Card slot is accessible to either the on-board MCF51JM MCU or a compatible Tower Module




The USB connector is used to provide power to the TWR-LCD module when operating in stand-alone mode (not connected to the Tower System)

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What's the Freescale Embedded GUI?

- ▶ High level object graphic driver for color LCD
- ▶ Structure of driver brings complete SW solution for applications with LCD screen
- ▶ Touch screen capability
- ▶ Organization done by screen with objects
- ▶ We can find the Alias references to **D4D** (Driver for Display) in function software



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Block scheme of FGUI implementation

- ▶ User application – layer of user application code
- ▶ Application programmable interface – interface layer between user application and FGUI
- ▶ D4D high level – layer that manage all screens and objects (redraws, input keys, touch screen events etc.)
- ▶ LCD low level – manage communication with LCD and provides some basic function (Draw line, bitmap, circle etc.)
- ▶ HW – Freescale MCU board + LCD

SW	User application
SW API	User interface - API (D4D API)
SW D4D	LCD High level driver
	LCD Low level driver
HW	MCU (Freescale HCS08 / Coldfire)
	LCD module

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Features of Freescale Embedded GUI

- ▶ Multiple platform support. Tested on HCS08/MCF51– Flexis series 8-, 32-bit MCUs and MCF52xx
- ▶ Objects:
 - Button
 - Check Box / User handled Radio Button
 - Gauge
 - Icon
 - Label
 - Menu
 - Picture
 - Slider
 - Graph

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Freescale Embedded GUI Screen

- ▶ The basic item of FGUI structure is SCREEN
- ▶ The screen representing the real screen showed on LCD
- ▶ The screen definition contains:
 - list of all used objects on screen
 - function bodies:
 - OnInit
 - OnActivate
 - OnDeactivate
 - OnMain
 - OnObjectMsg

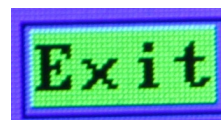
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Freescale Embedded GUI Button Object

- ▶ Button object is targeted for control of user functions



- ▶ Check Box object is targeted for control and set up of user application



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Freescale Embedded GUI Gauge Object

- ▶ Gauge object is targeted as a graphic information of numerical values



- ▶ Icon object is targeted as a graphic information



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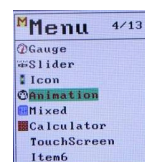


Freescale Embedded GUI Label object

- ▶ Label object is targeted as a text information



- ▶ Menu object is targeted as a control item



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Freescale Embedded GUI Picture object

- ▶ Picture object is used only to draw bitmap on screen



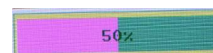
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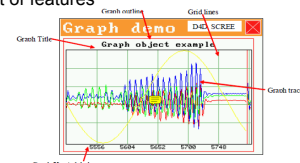


Freescale Embedded GUI Slider object

- ▶ Slider object is targeted as a graphic information of numerical values and for setting this numerical values



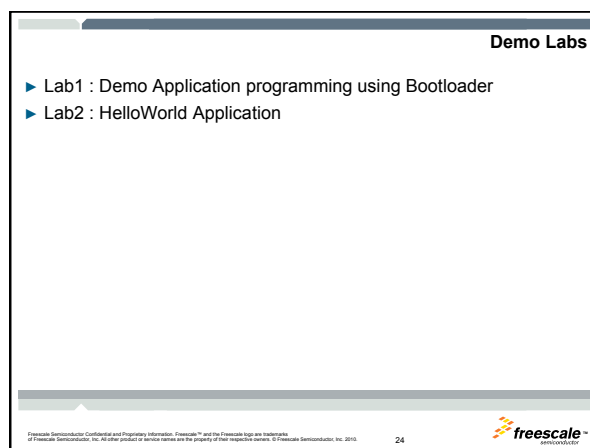
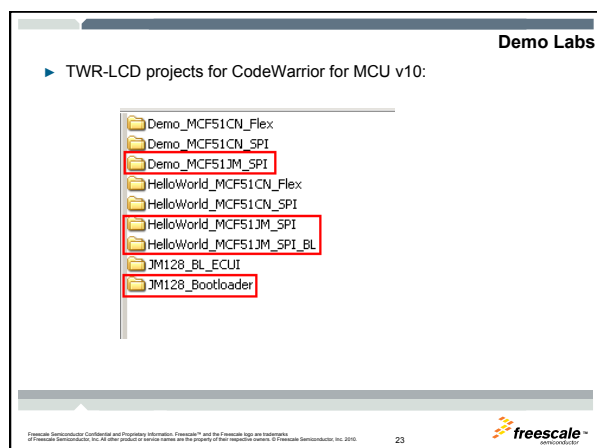
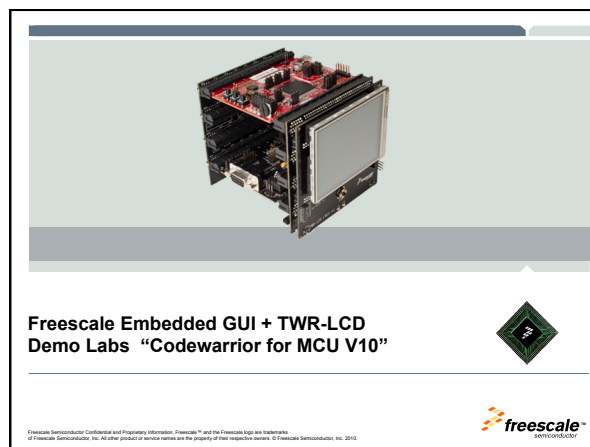
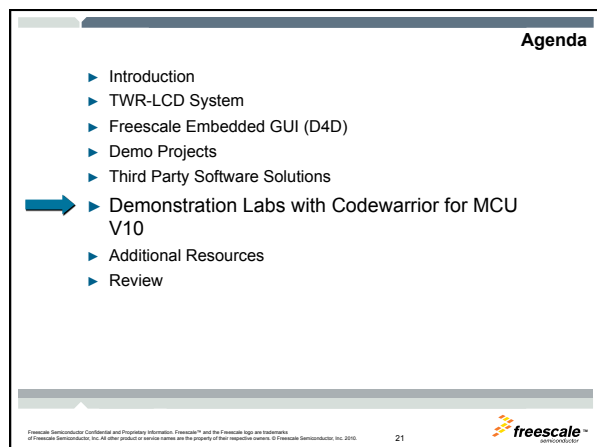
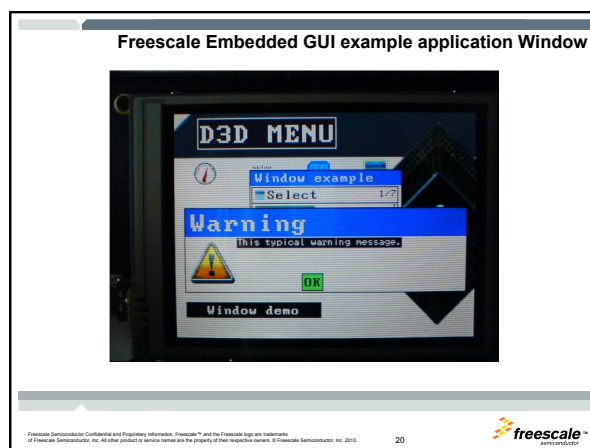
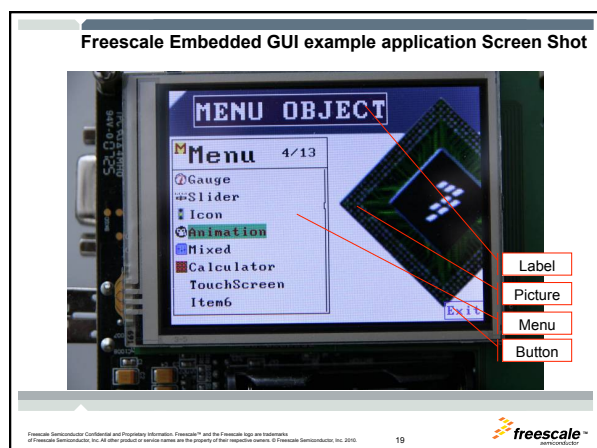
The D4D_GRAPH object is prepared to create a simple graph that provides a lot of features

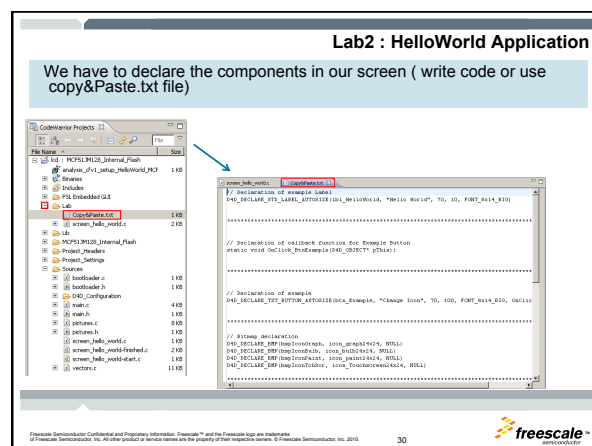
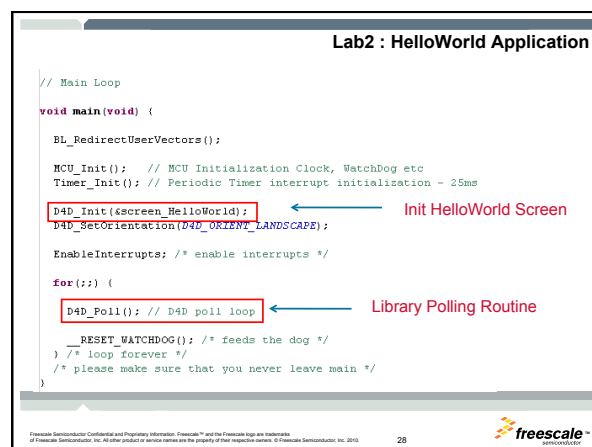
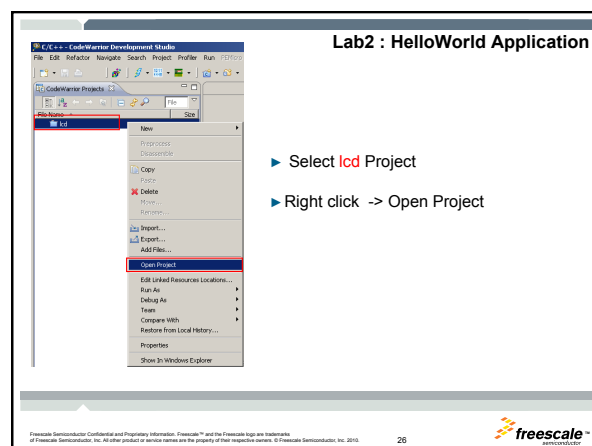


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Lab2 : HelloWorld Application

Write code under "INCLUDE YOUR DECLARATION CODE HERE"

- Label Declaration:
`D4D_DECLARE_STD_LABEL_AUTOSIZE(lbl_HelloWorld, "Hello World", 70, 10, FONT_8x14_BIG)`
- Text Button Declaration:
`D4D_DECLARE_TXT_BUTTON_AUTOSIZE(btn_Example, "Change Icon", 70, 100, FONT_8x14_BIG, OnClick_BtnExample)`
- BitMaps:
`D4D_DECLARE_BITMAP(bitmapGraph, icon_graph24x24, NULL)`
`D4D_DECLARE_BITMAP(bitmapBulb, icon_bulb24x24, NULL)`
`D4D_DECLARE_BITMAP(bitmapPaint, icon_paint24x24, NULL)`
`D4D_DECLARE_BITMAP(bitmapTchScr, icon_Touchscreen24x24, NULL)`

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Lab2 : HelloWorld Application

- Icon with 4 bitmaps Declaration:
`D4D_DECLARE_STD_ICON_BEGIN_AUTOSIZE(icon_Example, "Icon", 120, 150, FONT_8x14, NULL)`
`D4D_DECLARE_ICON_BITMAP(bitmapIconGraph)`
`D4D_DECLARE_ICON_BITMAP(bitmapIconBulb)`
`D4D_DECLARE_ICON_BITMAP(bitmapIconPaint)`
`D4D_DECLARE_ICON_BITMAP(bitmapIconTchScr)`
`D4D_DECLARE_ICON_END()`
- Screen with 3 objects Declaration:
`D4D_DECLARE_SCREEN_BEGIN(screen_HelloWorld, ScreenHelloWorld_)`
`D4D_DECLARE_SCREEN_OBJECT(lbl_HelloWorld)`
`D4D_DECLARE_SCREEN_OBJECT(btn_Example)`
`D4D_DECLARE_SCREEN_OBJECT(icon_Example)`
`D4D_DECLARE_SCREEN_END()`

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Lab2 : HelloWorld Application

We have to add the callback function code for Button Touch/Click event under "INCLUDE YOUR BUTTON CALLBACK CODE HERE"

```

D4D_UNUSED(pThis);
D4D_IconChangeIndex(&icon_Example, 1);

static void OnClick_BtnExample(D4D_OBJECT* pThis)
{
    D4D_UNUSED(pThis);
    D4D_IconChangeIndex(&icon_Example, 1);
}
    
```

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Lab2 : HelloWorld Application

- Build Application

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Lab2 : HelloWorld Application

- Find the S19 application output file:
`C:\CW10\workspace\lcd\MCF51JM128_Internal_Flash\HelloWorld_MCF51JM_SPI_BL.elf.S19`

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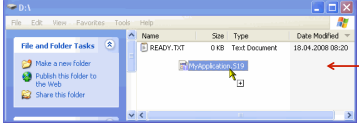
Lab2 : HelloWorld Application

- Connect USB cable to TWR-LCD

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Lab2 : HelloWorld Application

- ▶ Drag&Drop S19 output file to bootloader Drive



Bootloader mode: waiting for S19 file...
Loading S19 file...
Loading successful!
You can reset the board now.

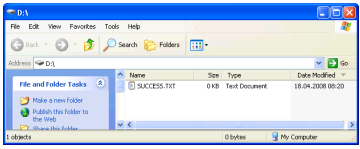
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Lab2 : HelloWorld Application

- ▶ Additionally the MSD (Mass storage device) will show 'SUCCESS.TXT'



- ▶ Now you can reset the board (pressing JMRST), and this will launch your HelloWorld Application

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Lab2 : HelloWorld Application

- ▶ Touch the Button to change the icon image.



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TWR-LCD Documentation



- ▶ TWR-LCD User Manual
- ▶ TWR-LCD Lab Guide
- ▶ Freescale_Embedded_GUI_User_Manual
- ▶ TWR-LCD-RevA-SCH : TWR-LCD Schematic
- ▶ TWR_LCD_QSG : TWR-LCD Quick Star Guide
- ▶ SSD1289 : Display Controller Datasheet
- ▶ TRULY-TFT2N0369-E : Truly Display Datasheet

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Lab1 : Demo Application programming using Bootloader

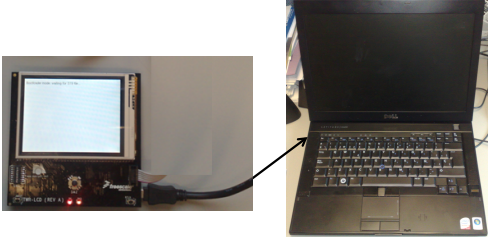
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Lab1 : Demo Application programming using Bootloader

- ▶ Connect USB cable to TWR-LCD



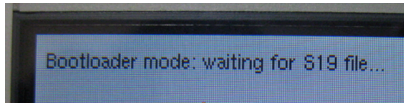
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Lab1 : Demo Application programming using Bootloader

- ▶ The TWR-LCD features a bootloader to facilitate the loading of applications without the need for an external debugger.
- ▶ Bootloader will enumerate the TWR-LCD JM128 as a MSD (Mass Storage Device).
- ▶ To enter the bootloader hold the 'BTLD' button while momentarily pressing the 'JMRST' button and finally releasing 'BTLD'.
- ▶ In bootloader mode, you will hear a beep from the sounder and the screen will write a welcome message.

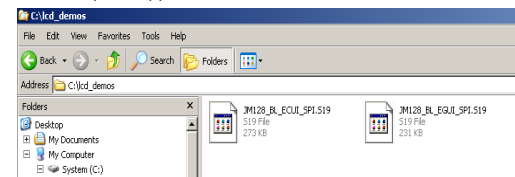


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**Lab1: Demo Applications Programming**

▶ Precompiled Applications:



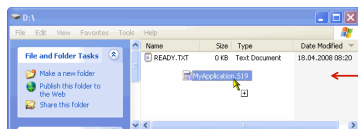
- ▶ Now you can drag&drop / copy S19 (Motorola S-Records) precompiled applications files to the bootloader

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**Lab1: Demo Applications Programming**

- ▶ Drag&Drop S19 Demo file to bootloader



Bootloader Drive

- ▶ The bootloader will load the file and flash the application

```

Bootloader mode: waiting for S19 file...
Loading S19 file...
Loading successful!
You can reset the board now.
  
```

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**Lab1: Demo Applications Programming**

- ▶ Additionally the MSD (Mass storage device will show 'SUCCESS.TXT')



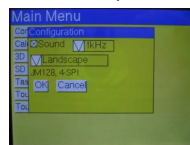
- ▶ Now you can reset the board (pressing JMRST), and this will launch your new application

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**Lab1: Demo Applications Programming**

- ▶ Flash and Explore the Applications:



JM128_BL_EGUI_SPI.S19

JM128_BL_EGUI_SPI.S19



If an application is already loaded, then you need to reset the board (press the JMRST button) while holding down the BTLD button

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